an appropriate intensity of light in each case to balance the gravity stimulus without any effect on geotropic sensitiveness itself. Thus in the coleoptile of *Avena sativa* light of about 55 meter-candles, in the hypocotyls of *Brassica Napus*, *Lepidium sativum*, and *Agrostemma Githago* respectively 525, 666, 1026 m.-c., compensates gravity when each stimulus acts at 90°. When equivalent light acts at right angles to gravity (plants vertical, light horizontal) the parallelotropic organs take a resultant position, departing about 45° from the direction of each. On the elimination of the one-sided action of gravity by the clinostat, however, they become parallel to the light rays; but even in the final position of rest they have not lost their sensitiveness to gravity.

The geotropic series of reactions is quicker than the heliotropic, when the light is reduced to the compensating point; consequently, when light and gravity act antagonistically, the geotropic curvature appears first, and the maximum of heliotropic stimulation does not appear until much later. While these results are strictly true only for the plants observed, yet the principle is probably valid for others.—C. R. B.

Development of Juniperus.—Two preliminary accounts of fertilization in Juniperus were noted in this journal (**40**:318. 1907). The two accounts differed mainly in regard to time relations, NORÉN stating that the interval between pollination and fertilization was over a year, while SLUDSKY claimed that the development from megaspore to embryo occupies only a single summer. The present account[11] shows that NORÉN was right, SLUDSKY having made a mistake in estimating the age of the cones. The pollen grain in the uninucleate condition reaches the nucellus the middle of June and soon divides into a tube cell and generative cell, the latter remaining undivided until the following May, when it forms the stalk and body cells. Early in July the body cell gives rise to two equal male cells. In the nucellus there are several sporogenous cells, only one of which divides to form megaspores, the others becoming a nutritive jacket about the functioning megaspore. Usually only three cells of the tetrad are formed. In the archegonium there are four neck cells; and a ventral canal nucleus is formed, but never becomes separated from the egg by a wall. Fertilization occurs about the middle of July and the fusion nucleus passes to the bottom of the egg, where three mitoses give rise to eight free nuclei which become arranged in two zones. Walls now appear and the cells of the upper zone divide to form the rosette and suspensor.

The account is very full, cytological details of reduction and fertilization being figured and described.—CHARLES J. CHAMBERLAIN.

Hygroscopic movements of living leaves.—The leaves of some species of Rhododendron exhibit variation movements which follow the recurrence of freezing and thawing weather. The usual position of the leaves is horizontal, with the blade expanded. At freezing temperatures the edges of the leaves curl

[11] NORÉN, C. O., Zur Entwickelungsgeschichte des *Juniperus communis*. Uppsala Universitets Årsskrift **1907**:1–64. *pls. 4*.

under and the petioles allow drooping to occur. With the recurrence of thawing weather the blades expand and the leaf resumes its horizontal position. HANNIG[12] has found that the rolling of the leaf is due to a loss of imbibition water by the cell walls, and especially by the walls of the spongy parenchyma. The movements may be artificially induced by conditions which cause the cell walls to lose water and so allow a contraction of the walls to occur. The formation of ice, excessive transpiration, etc. are such conditions. The author is inclined to regard this as the first known instance of hygroscopic movements by living leaves. To the reviewer it seems that he has made a closer analysis of the cause of the movements, and his discovery consists in showing that while turgor variation is a prominent and accompanying feature, the real cause is the fluctuation in the content of imbibition water in the cell walls. It seems likely that many of the leaf movements which have hitherto been regarded as due to turgor changes may later be found to be caused by swelling and shrinkage of the cell walls. The author has not overlooked the fact that some leaves whose structure is apparently as well adapted to such movements as those of Rhododendron do not exhibit them.—RAYMOND H. POND.

Embryo sac of Nymphaea advena.—Miss SEATON[13] has examined the embryo sac of this species, giving an account of its earlier stages. Abundant material has enabled her to fill in some desirable details. The archesporium is distinguishable before the integuments begin to develop; and by division of the parietal cell and the epidermal cells the functioning megaspore becomes covered by a sterile nucellar cap six to ten cells deep. The sac develops a conspicuous tubular prolongation into the chalaza, and the fusion nucleus rests in the narrow connection between this chalazal haustorium and the broader micropylar portion of the sac. At the first division of this nucleus there is no wall (contrary to previous observation), and one of the daughter nuclei passes to the end of the chalazal tube. As before reported for the family, the proembryo is spherical and almost completely invested by endosperm. The monocotyledonous character of Nymphaeaceae is inferred, but no new evidence for it is advanced. This claim, which habitually accompanies the recent studies of Nymphaeaceae, is founded upon certain rigid preconceptions as to what constitutes a monocotyledon. It might be well for investigators of this group to try the effect of their work upon the rigidity of the old definitions.—J. M. C.

Araucarians of the Atlantic coastal plain.—BERRY[14] has called attention anew to the wide distribution of araucarians in the Mesozoic, especially as contrasted with their present very restricted range. A Mesozoic distribution of the

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[12] HANNIG, E., Ueber hygroskopische Bewegungen lebender Blätter bei Eintritt von Frost und Tauwetter. Ber. Deutsch. Bot. Gesells. **26a**:151–166. 1908.

[13] SEATON, SARA, The development of the embryo sac of *Nymphaea advena*. Bull. Torr. Bot. Club **35**:283–289. *pls. 18, 19*. 1908.

[14] BERRY, EDWARD W., Some araucarian remains from the Atlantic coastal plain. Bull. Torr. Bot. Club **35**:249–260. *pls. 11–16*. 1908.